river in that section on which river and flood service is maintained.

The work of extension of the River and Flood Service has progressed steadily since July 1, 1904, the date on which the increased appropriation for that purpose became available, and by the end of September new stations had been established as follows:

Milk River, Havre, Mont.; Big Blue River, Blue Rapids, Kans.; Republican River, Clay Center, Kans.; Solomon River, Beloit, Kans.; Smoky Hill River, Lindsborg, Kans., Abilene, Kans.; Kansas River, Manhattan, Kans., Topeka, Kans.; Gasconade River, Arlington, Mo.; Missouri River, Blair, Nebr.; Minnesota River, Mankato, Minn.; St. Croix River, Stillwater, Minn.; Red Ceder River, Cedar Rapids, Iowa; Iowa River, Iowa City, Iowa; Scioto River, Circleville, Ohio; Kentucky River, Jackson, Ky.; Powell River, Tazewell, Tenn.; Little Tennessee River, McGhee, Tenn.; St. Francis River, Marked Tree, Ark.; Neosho River, Neosho Rapids, Kans., Iola, Kans., Oswego, Kans., Fort Gibson, Ind. T.; Canadian River, Calvin, Ind. T.; Black River, Blackrock, Ark.; White River, Calicorock, Ark., Batesville, Ark., Clarendon, Ark.; Arkansas River, Tulsa, Ind. T.; Mississippi River, St. Cloud, Minn., Warsaw, Ill., Luxora, Ark.; Lehigh River, Mauchchunk, Pa.; Schuylkill River, Reading, Pa.; Delaware River, Hancock, N. Y. (east branch), Hancock, N Y. (west branch), Port Jervis, N. Y., Phillipsburg, N. J., Trenton, N. J.; Catawba River, Mount Holly, N. C.; Oconee River, Milledgeville, Ga.; Yuba River, Colgate, Cal.; Sacramento River, Knights Landing, Cal., Riovista, Cal.

Nineteen rainfall stations have also been established, and there remain to be established about 35 river and a few rainfall stations.

The highest and lowest water, mean stage, and monthly range at 228 river stations are given in Table VII. Hydrographs for typical points on seven principal rivers are shown on Chart V. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfield, Professor.*

CLIMATE AND CROP SERVICE.

By Mr. JAMES BERRY, Chief of Climate and Crop Divison.

The following summaries relating to the general weather and crop conditions during September are furnished by the directors of the respective sections of the Climate and Crop Service of the Weather Bureau; they are based upon voluntary reports from meteorological observers and crop correspondents, of whom there are about 3000 and 14,000 respectively:

Alabama.—Some locally heavy rains, but generally dry, hot weather prevailed, except rather cool middle of month; light frost in Walker County on 16th. Cotton continued to deteriorate from rust and shedding during first two decades, some damage by bollworms and premature opening, greater portion open by close of month, when over one-half picked. Gathering of early corn progressed slowly, yield continuing very good. Minor crops fairly good, though all late crops injured by drought.—*F. P. Chaffee.*

Arizona.—The rainfall during September was generally less than normal, but crops did not suffer from lack of moisture. Temperatures were generally moderate, but the latter part of the month was rather cool, and light frosts occurred in northern districts. But little damage resulted, however, as crops were too far advanced. The month was generally favorable to agricultural interests, and crops did well. Grass was abundant on ranges, and it cured nicely as hay, promising plenty of winter feed. Stock was in fine condition.—*M. E. Blystone.*

Arkansas.—The temperature was excessive and the rainfall deficient; drought caused late crops to deteriorate. Cotton opened rapidly; picking general at close of month; top crop light. Good crop of early corn being gathered; late promised a poor crop owing to lack of moisture. Irish potatoes fair crop; sweet potatoes good crop. Less than usual acreage sown to fall grains, as ground was too dry to plow. Apples fair crop of medium quality.—*O. C. Burrows.*

California.—Temperature and rainfall records were both broken during the month. At San Francisco the maximum temperature on the 8th, 101°, was the highest ever recorded for any month. The rainfall at San Francisco from the 22d to 26th, 5.07 inches, was 4.80 inches above the average for thirty-three years, and it was equally heavy throughout the central and northern sections, with abnormally heavy downpours in portions of southern California. Thunderstorms were more severe and frequent than usual in all parts of the State. Heavy snow fell in the high Sierra. Grapes, beans, grain in sacks, and unprotected hay were quite seriously damaged by rain.—*Alexander G. McAdie.*

Colorado.—Month favorable; fore part too dry for plowing and sowing, but drought relieved during last decade. Grain harvest, haying, and fodder cutting finished; thrashing under way; beet pulling and potato digging begun. Corn somewhat damaged by frost on 13th and 14th, but by close of month generally out of danger of further damage. Range cured well, but was considerably damaged by heavy rains during closing days. Fine crops of fruit and melons marketed.—*F. H. Brandenburg.*

Florida.—Cotton picking was generally favored by the lack of rain and at the close of the month cotton was about three-fourths harvested; on account of the ravages of caterpillars and other insects the yield was considerably below the average. Corn was mainly housed with fairly satisfactory yields. Cane did well and cutting had commenced in some localities. Citrus fruits had begun to color in the central districts, and marketing had begun south. Fruit trees looked well, but gardens showed lack of rain.—*R. T. Lindley.*

Georgia.—An unusually warm and dry September. During the first half cotton was damaged by rust, shedding, and caterpillars, top crop a failure; bolls opened fast, many prematurely; picking progressed rapidly, staple generally marketed as fast as ginned; labor scarce; yield above average; crop about all gathered in southern section, with rapid advance elsewhere. All minor crops seriously injured by drought. Corn crop being housed, yield good. Large crops of fodder and hay saved. Very little fall plowing.—*J. B. Mabury.*

Idaho.—The first two decades of the month were clear, warm, and dry; during the last ten days there was an increase in cloudiness and wind movement and occasional light showers. Weather was very favorable for the harvesting of all crops. Packing and shipping of prunes was nearly complete by the end of the month. Ranges became very dry, but stock was generally in good condition. Shipping of cattle and sheep was active during the month.—*Arthur W. Garrett.*

Illinois.—Fall plowing was actively prosecuted during the first decade and some seeding was done. Corn was generally reported to be late. Light frosts formed on the 15th, but no material damage ensued. Reports received during the second decade indicated a more favorable outlook for apples in the northern half. At the end of the month a considerable proportion of the corn crop was safe from frost in the southern half, and it was reported that the bulk of the crop in all sections would be safe by October 10.—*Wm. G. Burns.*

Indiana.—Dry until the 12th, but sufficient moisture afterward. Corn was nearly all matured in the northern and southern sections, but in the central section about 10 per cent was yet in danger from frost; cutting and shocking began about the 15th. Plowing, wheat and rye seeding, cutting and housing tobacco, hulling clover, and digging potatoes were nearly completed, clover and potatoes yielded fair and tobacco generally poor. Apples were faulty and fell badly.—*A. F. Randall.*

Iowa.—With temperature about normal, and less than average rainfall, the conditions were generally favorable for ripening corn and other belated crops. The most serious drawback was the occurrence of light to heavy frosts on the 14th, 15th, and 21st, but damage to immature corn was light, being limited to lowlands and relatively small portion of area planted. The fine weather in the closing decade brought 90 per cent of the crop to maturity. As a whole the season was favorable.—*John R. Sage.*

Kansas.—Corn cutting continued. Late corn filled well, was nearly all hard, well matured, and out of danger from frost. Wheat sowing began first week, was well advanced the last week. The early sown wheat came up, showing a good stand. A large crop of fine prairie hay was put up. The fourth cutting of alfalfa began the last week. Apple picking began the last week, generally a good crop. Potato digging began. Pastures good.—*T. B. Jennings.*

Kentucky.—The rainfall was nearly normal, but as it was irregularly distributed, some localities suffered from drought while others had abundant rain. High temperatures were reported from 1st to 3d and from 24th to 30th, but moderate temperature prevailed at other times. Light frost occurred in many places on the 15th and 16th, but the damage was slight. The weather was generally favorable for maturing and harvesting crops, and at the end of the month nearly everything was secured except late fields of tobacco and corn. Sowing of wheat progressed well during the last week.—*H. B. Hersey.*

Louisiana.—Showers early in the month interfered with cotton picking and caused some seed to sprout in the bolls. Dry, warm weather later caused cotton to open rapidly and picking was pushed forward, although

labor was scarce in some localities. Sugar cane was very rank and needed cool weather to develop the sucrose content. Rice harvest was retarded by local rains, and some damage resulted, but the bulk of the crop was housed under favorable conditions. Corn gathering was well advanced. Hay making was about completed. Truck gardens suffered for rain.—*I. M. Cline.*

Maryland and Delaware.—The month was deficient in effective moisture, and the yields of nearly all late crops were considerably reduced in consequence. The severe storm on the 14th damaged outstanding crops and shipping. Heavy to killing frost on the 22d injured some late corn, tobacco, and vegetables. The month was excellent for curing tobacco. During the last half corn cutting and fall seeding made rapid progress, the soil being in splendid condition.—*Oliver L. Fassig.*

Michigan.—Most of September, especially the nights, was too cool for the best maturity of corn and beans, which ripened slowly and unevenly, but most of the crops were safe before the heavy and killing frosts that occurred during the last decade. Wheat and rye seeding advanced rapidly during the latter half of the month and germination was splendid. The yield of apples and grapes was good and sugar beets were very promising. Late potatoes were fairly well matured.—*C. F. Schneider.*

Minnesota.—Much flax and latest wheat, oats, and barley were cut early in month. Thrashing progressed well when grain was dry enough. Cutting late clover for hay, plowing, and potato digging went on during most of the month. Frost on the 20th, 21st, and 22d killed most vegetation in north half, but in south very little injury by frost at close of month. Corn cutting began early and continued throughout the month.—*T. S. Outram.*

Mississippi.—The dry weather over the north-central and western counties caused cotton to open prematurely; heavy rains on the 23d damaged open cotton in Scott, Newton, and Lauderdale counties; shedding and bollworms were also damaging to cotton in many localities; bolls opened rapidly and picking made fairly good progress, although labor was scarce. Where rains were sufficient minor crops did well, but fall crops were generally poor. The last decade of the month was unusually warm.—*W. S. Belden.*

Missouri.—Late corn matured slowly during the first half of the month, owing to cool nights; frost occurred on the 14th and 15th causing no damage. Favorable weather followed, and by the close of the month three-fourths of the entire corn crop was safe from damage by killing frost. Wheat seeding made excellent progress, coming to good stand and fields showing green. Cotton picking began about the 20th, and potato digging about the third week. A good hay crop was secured.—*George Reeder.*

Montana.—The temperature was generally favorable for crops not yet matured, and there was no material damage by frost except to potatoes in places. Rain was needed in nearly all sections; range feed very short as a rule. Cutting of second and third crops of alfalfa in progress throughout the month. Wheat and oat harvests completed during the third week and thrashing by the close of the month. Potatoes were a fair crop. Apples matured and were of excellent quality.—*R. F. Young.*

Nebraska.—September was almost exactly a normal month as far as temperature and rainfall were concerned. Corn matured well and without injury by frost, the crop as a whole being a very good one. Haying in some late fields was completed, and the third crop of alfalfa was secured in good condition. A considerable acreage of winter wheat was sown under favorable conditions, while early sown wheat came up quickly and made excellent growth.—*G. A. Loveland.*

Nevada.—Generally fair weather prevailed over the State during the month, with about normal temperature and light precipitation. Conditions were favorable for maturing late crops, harvesting grain, and baling hay. No damaging frost occurred. Range feed was fairly good and live stock did well.—*J. H. Smith.*

New England.—The storm of the 14–15th was heavy and very general, giving at many stations over half of the monthly precipitation and causing winds of hurricane force on the southern New England coast. The killing frosts and freeze of the 22d and 23d were unusually early. Excepting the storm and frosts mentioned, the weather was characteristic of the season and very favorable for maturing and securing crops and for fall plowing and seeding.—*J. W. Smith.*

New Jersey.—The month was favorable for all farming operations; late maturing crops suffered materially from drought during the first half. Heavy rains, 14–15th, accompanied by high winds, were very destructive to standing crops; fruit blown from the trees and newly seeded fields and side hills badly washed. First killing frost, morning of 22d, did great damage to late corn and vine truck. At close of month seeding of wheat was not completed in southern section.—*Edward W. McGann.*

New Mexico.—Crops were generally secured before frosts, except in mountain districts of the north, where late planted vegetables and maturing grains were damaged. The prospects for winter feed were considered good. Stock was in very fair condition at close of the month. Heavy rains during the last four days of the month caused extensive and destructive floods, washed away bridges and railroad tracks, carried away houses and crops in valleys and lowlands, and caused some loss of life.—*J. B. Sloan.*

New York.—The weather during September was mostly favorable for farm work and the maturing of crops until the 22d, when killing frosts occurred, which considerably damaged buckwheat and corn, and apples in places. Light frosts had occurred on several previous dates. Seeding wheat and rye was finished and many fields were beautifully green. High winds in eastern New York on the 14th greatly damaged corn and apples, and disastrous gales on the 30th caused at least a third of the apples to drop.—*R. G. Allen.*

North Carolina.—The weather was generally quite favorable for harvesting crops. A severe storm on the 14th and 15th caused some damage by heavy rains and high winds in the central portion of the State. Cotton opened quite rapidly and picking became general about the middle of the month; the crop was reduced below the average by continual shedding. The curing of tobacco was completed, with good results as to quality, but with a small yield. Corn matured well. Minor crops, forage, and hay yielded well.—*C. F. von Herrmann.*

North Dakota.—The weather during the fore part of the month was unfavorable for farm work, as rain prevailed in all sections, with low temperature both day and night. Clear, warm weather followed, when it turned cold again, with a killing frost in the Missouri Valley, destroying all unmatured crops. Rain prevailed again in the eastern portion, followed after the 25th by a killing frost in all parts of the State, destroying all vegetation, but there was little damage, as all crops, except some late flax and corn, had matured.—*F. J. Rupert.*

Ohio.—The rainfall was deficient, especially over the southern portion. Wheat was far below the average in most places. Buckwheat good yield. Corn not damaged by frost, except in the northeast, but the yield was generally below normal. Pastures short. Clover seed poor yield. Considerable progress made in seeding of winter wheat. Tobacco good crop and nearly all housed. Potatoes good in quantity and quality. Grapes and pears good; peaches fair; apples fair to good.—*J. Warren Smith.*

Oklahoma.—The month was warm, with nearly normal precipitation; light frosts occurred over the Cherokee Nation on the 15th, causing no damage; fall plowing and wheat seeding well advanced over Oklahoma, but greatly retarded over the Indian Territory by hard ground; cotton picking progressed with poor to good yields; broom corn, kafir corn, cane, hay, and all forage crops were secured with good yields; pasturage continued in fair condition, but some stock were being fed.—*C. M. Strong.*

Oregon.—The month was dry and smoky, and vegetation suffered greatly for want of rain. Light showers fell during the last week, but beyond clearing the atmosphere of smoke and somewhat reviving pastures and gardens they were of little benefit. Some seeding was done in the western section by disking in grain on land plowed last spring. No plowing to speak of was accomplished. Hop picking was completed without interruption; the yield was below average.—*A. B. Wollaber.*

Pennsylvania.—Temperature and rainfall seasonable, but drought conditions prevailed in many districts during last decade. A large acreage of late corn, tobacco, buckwheat, garden truck, and fruit on lowlands was ruined by frost on 22d and 23d. At close of month plowing, seeding, harvesting, and thrashing were practically completed, but complaints were numerous that late sown grain had failed to germinate and meadows and pastures were failing rapidly in drought districts.—*T. F. Townsend.*

Porto Rico.—Heavy showers early in the month relieved the drought and favorable weather followed. At the close of the month all crops were in good condition. Coffee picking continued; the yield was light, but quality of the berry good. Many small plots of cotton were picked. Small crops, such as rice, corn, and beans, were harvested. The preparation of land and the planting of cane for gran cultura progressed as fast as practicable. Some tobacco was sown. Fruits and small crops were generally plentiful.—*E. C. Thompson.*

South Carolina.—Temperature variable, averaging about normal. Precipitation was excessive in the northeastern group of counties, and deficient in other parts of the State, where drought became severe and the ground too dry for fall plowing and seeding. Weather favorable for haying, rice harvest, and picking cotton, the bulk of which opened and was picked in the eastern and central counties and less than half in the western. It was too hot and dry for fall truck, late corn, peas, and root crops.—*J. W. Bauer.*

South Dakota.—Dry weather retarded plowing, but conditions were generally favorable for field work and for maturing late crops. Frost on 14th and 21st, however, probably rendered one-fifth of the corn crop unmerchantable. The month closed with thrashing and potato harvest satisfactorily advanced, corn cutting progressing favorably, millet harvest and haying finished, flax harvest practically completed, and probably one-tenth of the late corn in the lower Sioux River Valley exposed to injury from frost.—*S. W. Glenn.*

Tennessee.—Lack of sufficient moisture caused growing crops to make but little progress and delayed plowing. The conditions were favorable for saving hay and the ripening of early corn. Late corn was greatly damaged by the drought. Cotton opened rapidly, and was generally about one-half gathered by the end of the month. A good tobacco crop was housed. Fall apples were inferior.—*H. C. Bate.*

Texas.—Generally favorable weather conditions prevailed over the section during the entire month. The cotton crop was not materially affected one way or the other by the rainfall of the month; there was some fruiting but this was completely destroyed by insect pests, leaving no prospect whatever of a top crop; the bolls opened very rapidly and

SUMMARY OF TEMPERATURE AND PRECIPITATION BY SECTIONS, SEPTEMBER, 1904.

In the following table are given, for the various sections of the Climate and Crop Service of the Weather Bureau, the average temperature and rainfall, the stations reporting the highest and lowest temperatures with dates of occurrence, the stations reporting greatest and least monthly precipitation, and other data, as indicated by the several headings.

The mean temperatures for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperature and precipitation are based only on records from stations that have ten or more years of observation. Of course the number of such records is smaller than the total number of stations.

Section.	Temperature—in degrees Fahrenheit.							Precipitation—in inches and hundredths.					
	Section average.	Departure from the normal.	Monthly extremes.					Section average.	Departure from the normal.	Greatest monthly.		Least monthly.	
			Station.	Highest.	Date.	Station.	Lowest.	Date.			Station.	Amount.	Station.	Amount.
Alabama	76.8	+ 2.5	Newbern	104	29	Ashville, Hamilton.	40	16	1.36	−1.52	Daphne	5.11	3 stations	0.00
						Valley Head	40	16						
Arizona	73.2	— 1.5	Aztec	112	3	Flagstaff	26	28	0.63	−0.51	Pinal Ranch	2.39	5 stations	0.00
			Parker	112	6									
Arkansas	75.4	+ 2.1	Heber, Warren	101	10	Oregon	37	15	2.46	−0.77	Russellville	6.18	Blanchard	0.16
California	70.3	+ 1.6	Elmdale	113	8	Bodie	15	19	2.66	+2.29	Pine Crest	10.95	15 stations	0.00
			Healdsburg	113	7									
Colorado	57.4	+ 0.2	Wray	97	8	Lost Canyon	18	3	2.03	+1.01	Trinidad	6.78	Delta	0.33
Florida	79.4	+ 0.4	Molino	102	29, 30	Inverness	50	1, 10, 11	4.36	−2.59	Jupiter	8.92	Pensacola	0.29
			Marianna	102	30									
			Clermont	102	6									
Georgia	76.0	+ 1.7	Lumpkin	104	30	Diamond	44	16, 24	1.48	−2.12	St. Marys	9.55	3 stations	T.
Idaho	59.1	.....	Blue Lakes	101	8	Chesterfield	21	14	0.37	.....	Oakley	0.90	Vernon	T.
Illinois	67.1	+ 0.4	Equality	99	11	Lanark	32	15	5.10	+1.78	McLeansboro	10.11	Cairo	1.91
Indiana	67.1	+ 0.3	Rome	99	1, 7	Bluffton	32	22	3.44	+0.63	Washington	6.02	Moores Hill	2.01
Iowa	64.0	+ 0.4	Wilton Junction	94	11	Atlantic	30	14	2.78	−0.52	Keokuk	8.33	Ida Grove	0.09
						Earlham, Hanlontown.	30	15						
						Rock Rapids	30	21						
Kansas	70.2	+ 1.6	Ellsworth, Gove	103	9	Achilles	25	14	2.60	0.00	Englewood	5.39	Pleasanton	0.64
			Medicine Lodge	103	9, 24									
Kentucky	71.1	+ 1.1	Beaverdam	99	1	Berea	34	15	2.58	−0.27	Fords Ferry	7.65	Beattyville	0.30
						Loretto	34	16						
Louisiana	79.5	+ 2.5	Monroe	103	30	Farmersville	49	16	3.59	−0.01	Donaldsonville	7.25	Minden	0.15
Maryland and Delaware	67.1	0.0	Boettcherville, Md.	99	3	Grantsville, Md.	27	22	3.61	−0.04	Annapolis, Md.	6.22	Grantsville, Md.	1.05
Michigan	59.2	— 0.8	Plymouth	91	11	Roscommon	18	22	3.68	+0.56	Mackinac Island	9.15	Ludington	1.16
Minnesota	57.4	— 1.0	Beardsley	98	9	Pokegama Falls	15	21	3.14	+0.11	Caledonia	7.91	Luverne	0.49
Mississippi	77.6	+ 2.7	4 stations	101	10, 11, 29	Ripley	39	16	1.51	−1.11	Meridian	6.53	2 stations	0.00
Missouri	69.6	+ 1.2	Caruthersville	96	11	Bethany, Seymour	34	15	3.85	+0.22	Booneville	9.72	Sarcoxie	0.53
Montana	56.4	+ 1.6	Decker	102	9	Chester	15	19, 25	0.27	−0.84	Lamedeer	1.42	5 stations	0.00
Nebraska	63.6	— 0.2	Lynch	105	9	Agate	15	14	1.98	−0.02	York	5.72	Central City	0.35
Nevada	60.4	— 0.7	Battle Mountain	103	8	Wabuska	19	28	0.93	−0.79	Austin	3.03	Ely	0.02
New England*	57.9	— 2.8	Woodstock, Vt.	88	18	Grafton, N. H.	18	23	5.31	−1.93	Patten, Me.	10.42	Nantucket, Mass.	0.78
			Chestnut Hill, Mass.	88	30									
			Norfolk, Mass	88	3									
New Jersey	64.8	— 1.2	Indian Mills	93	12	Charlotteburg	23	22, 23	4.79	+0.89	Freisburg	10.08	Tuckerton	0.89
New Mexico	64.4	0.0	Alamogordo, Carlsbad.	98	1	Luna	22	27	4.34	+2.37	Arabela	9.95	Fruitland	0.53
New York	59.1	— 1.0	Elmira	94	3	Paul Smiths	18	23	4.29	+1.08	Adams Center	8.24	Southampton	1.75
North Carolina	69.9	— 0.5	Lexington	99	30	Linville	31	16	3.26	−1.03	Pittsboro	7.81	Waynesville	0.39
North Dakota	54.7	— 2.3	3 stations	96	7, 10	Dickinson	18	14	1.65	+0.69	Wahpeton	6.44	Glenullin	T.
Ohio	65.5	0.0	Thurman	99	29	Orangeville	23	22	1.95	−0.76	Montpelier	4.47	Thurman	0.13
Oklahoma and Indian Territories.	74.9	+ 1.0	Waukomis, Okla.	106	9	Vinita, Webbers Falls, Ind. T.	38	15	2.55	+0.10	Healdton	6.23	Grand	0.24
Oregon	61.0	+ 2.7	McKenzie Bridge	100	3	Wallowa	24	19	0.75	−1.15	Bay City	2.71	Blalock	T.
Pennsylvania	63.7	+ 0.2	Irwin	95	29	Saegerstown, Smethport.	21	22	3.77	+0.14	Gordon	7.40	Lock No. 4	0.82
Porto Rico	78.3	.....	Manati	95	10	Adjuntas	57	23	9.28	.....	Las Marias	19.24	Coamo	3.36
			Central Aguirre	95	8									
South Carolina	75.8	+ 0.2	Anderson	101	30	Greenville, Santuc.	44	24	2.46	−1.65	Smiths Mills	9.50	Little Mountain	T.
South Dakota	61.0	— 0.1	Hotch City	110	9	Howell	21	21	1.06	−0.70	Ipswich	4.21	2 stations	0.00
Tennessee	72.3	+ 2.4	Pope	100	1, 11-13	Hohenwald	31	16	2.09	−0.98	Dyersburg	4.96	Bristol	T.
Texas	78.0	+ 1.4	Colorado	105	1	Texline	40	14	3.99	+0.89	Fort Clark	10.68	Brownwood	0.70
Utah	61.1	+ 0.6	Experiment Farm	102	7	Coyote	20	27	0.40	−0.38	Modena	2.02	2 stations	T.
			Rockville, St. George.	102	7	Loa	20	28						
						Woodruff	20	26, 28						
Virginia	68.4	— 0.7	Woodstock	96	3	Burkes Garden	28	16	2.32	−1.74	Wilkersons	5.07	Bristol	T.
Washington	60.2	+ 2.2	Trinidad	100	7	Northport	23	19	0.46	−1.54	Clearwater	3.07	7 stations	0.00
West Virginia	67.0	+ 0.8	Point Pleasant	95	29	Bayard	25	23	1.76	−0.98	Williamson	4.55	Lost Creek	0.43
Wisconsin	59.9	— 0.7	Prairie du Chien	92	28	Cranmoor (ex. sta.)	18	22	4.89	+1.58	Koepenick	9.20	Dodgeville	1.90
Wyoming	54.9	+ 1.1	Fort Laramie	104	8	South Pass City	10	14	0.46	−0.23	Moore	1.34	3 stations	0.00

* Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut.

picking was well advanced by the end of the month, being practically completed in the southwestern counties. Gathering of corn was delayed, owing to the great demand for labor in the cotton fields; early corn was good but late planting was badly damaged by the drought. Rice harvesting was interrupted by the rains, but good progress was generally made. Cane matured nicely and prospects were good for an average crop. Considerable grain was sown under favorable conditions. Gardens did well. Pastures and stock were in excellent condition. The hay crop was fine.—*W. H. Alexander.*

Utah.—Fine warm weather during the first two decades was followed by rains, colder weather, and killing frost. Crops were nearly all housed in good condition, except beets and potatoes, which were being housed. Sugar beets were above the average and sugar making was begun. Fall seeding was well advanced. Thrashing results from arid farms exceeded all expectations. Winter apples were abundant and of good quality. Alfalfa was above the average. Pasturage was good and stock were in good condition.—*R. J. Hyatt.*

Virginia.—The rainfall of the month was considerably less than the normal, and the temperature, also, was deficient. The tidewater section received ample rain for crop purposes, but in the central and mountain portions of the State conditions were more or less droughty. Little injury occurred to crops, however, as they were generally too far advanced to be materially affected by weather conditions. Harvest of late corn and tobacco was finished during the month. Fall seeding was delayed by the dry weather.—*Edward A. Evans.*

Washington.—The month was dry and warm, with considerable smokiness. The rain of the 8th laid the dust west of the Cascade Mountains, and none fell on the east side; the rain of the 22d was general over the State, with scattering showers to 28th, except in central part, where none fell. Wheat, oats, barley, and hay, were garnered in excellent condition. All crops were below the average. Fall seeding progressed. Potato crop light. Apples fine crop; pastures revived at end of month.—*William Bell.*

West Virginia.—Drought continued during the entire month, and seriously affected vegetation. Fall plowing progressed slowly, and considerable seeding remained to be done. Corn was not much damaged by

frost. At the close of the month corn was mostly in shock, and buckwheat was mostly harvested, with fair yields of both. Late corn dried up, and was mostly cut for fodder. Pastures were very short and water scarce, but stock were in fair condition. Winter apples were being picked with prospects of about a half crop.—*E. C. Vose.*

Wisconsin.—A general frost occurred at most points in the interior on the 15th, 21st, and 22d. Pasturage was excellent for the season throughout the month, and fall seeding of winter wheat and rye obtained an excellent start. The rains interfered to some extent with the digging of potatoes, but a large crop was secured without damage. Much corn failed to ripen and was cut for fodder. Apples were plentiful and of excellent quality.—*W. M. Wilson.*

Wyoming.—The month was favorable for the completion of haying and harvesting where that work was not completed during August. A good crop of grain was secured where the frosts of summer had not damaged the grain. Good range feed was general throughout the State, and stock were in excellent condition. The absence of any snow during the month over the greater portion of the State was very unusual for September.—*W. S. Palmer.*

SPECIAL ARTICLES.

A NEW THEORY OF FOG FORMATION.[1]

Translated by FRANK W. PROCTOR.

[Interpolations by the translator are in brackets.]

Of all the theories concerning the formation of fog, but two have been accepted up to recent times, one of which is now universally held. But it will appear that both are not in harmony with our observations [Aeronautical Observatory, Royal Meteorological Institute of Prussia], and with the latest physical investigations; and accordingly we must seek a new explanation.

* * * * * * *

The Davy-Dines theory [that condensation is due to the cooling of the earth's surface and its herbage by radiation] has been authoritative up to the present time, and is found in Hann's Lehrbuch der Meteorologie.

* * * * * * *

In order to show that this explanation does not satisfy the facts, exact moisture measurements in the neighborhood of the earth's surface are necessary. These were made in 1893 by Homén[2]; and it was shown by him that fog can not arise simply through the radiation of the ground. In view of the great importance of those investigations to the present study, let us look into the matter more closely. Homén observed that the dew-point fell at the earth's surface and in the lower air layers when dew began to form. It follows that as soon as the air at the earth's surface has cooled below the dew-point, the water vapor condenses out of the stratum immediately above the earth's surface on the cold underlying surface. Thereupon the vapor pressure diminishes considerably in the lowermost layer, and the vapor from the layers above comes to the earth's surface by diffusion, where it, also, is condensed. Thus there occurs a continuous progression of the water vapor from above downward.

Homén maintained that the downward diffusion at the bottom went on faster than the incoming of moisture from above, so that in spite of steady decrease of temperature, saturation could not occur.

The observations of Hamberg[3] and Rubenson[4] had before yielded a similar result. Hamberg found, for example, that at the beginning of the night, at six and six-tenths meters height above the earth's surface, the relative humidity rose from 70 to 90 per cent, and toward the end of the night from 95 to 98 per cent. From these observations Homén drew the above-mentioned conclusion. Nevertheless it would be conceivable that in cases where the drying goes on more slowly than the cooling, light fog might form.

On the answer to this last question, viz, whether the drying can proceed more slowly than the cooling, the decision in regard to the hitherto prevailing fog theory depends. Homén could have answered this through observation by means of his dew-point measurements[5] of August 12-13 and September 6-7, had he secured trustworthy synchronous temperatures. Then it would have appeared whether the cooling of the air, i. e., the conduction of heat, goes on faster than the diffusion of the water vapor. This question must therefore be answered in another way.

If we assume that at the height of one centimeter above the earth's surface, the air is saturated at t_1^0 while at the earth's surface dew making begins at t_0^0, then in the course of time vapor will diffuse from above downward, while simultaneously the higher temperature approaches the lower through conduction. For the sake of simplicity, let us assume that during the whole time the temperature of the earth's surface remains at t_0^0. Thus it becomes warmed neither by condensation nor through the importation of heat from above, and is not cooled through radiation, which is the more admissible as the different influences will more or less offset each other. The upper layer will thus finally acquire the temperature t_0^0 of the lower. Condensation will now begin in the upper layer if the vapor tension is at least equal to the vapor tension at t_0^0, or if less than the difference of water content which can exist in the air at t_1^0, and t_0^0 is diffused in the same time that is needed for the difference of heat $t_1^0 - t_0^0$ to pass by conduction through one centimeter.

A calculation of this kind, however, is not easily made. The same result is more conveniently reached if we calculate, on the one hand, the time required for the difference of water content of saturated air at t_1^0 and t_0^0 to diffuse through one centimeter, and, on the other hand, the time necessary to transmit a temperature difference of 1° one centimeter in the air.

It follows, then, that if the conduction of heat proceeds more rapidly than the diffusion of the water vapor fog formation can take place. In the opposite case, this is impossible.

The quantity, S, of a gas which in time Z passes by diffusion through a cross section, q, of a tube l centimeters long, when the density of the gas is d_0 at one end of the tube and d_1 at the other end, is, as is well known, expressed by the formula

$$S = kq\,\frac{d_1 - d_0}{l}\,Z,$$

or, when $d_1 - d_0 = d$,

$$S = kq\,\frac{d}{l}\,Z, \qquad (1)$$

where k is the coefficient of diffusion, i. e., the amount of gas which is transmitted through cross section 1 when all the other quantities on the right-hand side of the equation = 1.

For the present case we assume $q = 1$, and according to the foregoing assumption $l = 1$; then it follows that

$$Z = \frac{S}{kd}.$$

S is the quantity of water vapor diffusing in one cubic centi meter of air.[6] This amounts, at a vapor pressure[7] of e_1, to

$$S_1 = 1.060\,\frac{e_1}{1 + at_1}\,10^{-6}.$$

[1] *Extract from* Die Entsthung und Alflösung des Nebels von Hermann Elias. Berlin, 1904. *Reprinted from* Ergebnisse der Arbeiten am Aeronautischen Observatorium, 1 Oktober, 1901, bis 31 Dezember, 1902.

[2] Homén. Bodenphysikalische und meteol. Beobacht, 1894, p. 171 ff.

[3] Hamberg. Om nattfrosterna, etc., 1874, p. 84 *and* La température et l'humidité de l'air à differentes hauteurs. Nova Akta R. S. S. Upsaliensis. 1879, Vol. X, No. 4.

[4] Rubenson. Om temperatur-och fuktihetsförhållandena, etc. Öfversigt af K. Sv. Vet. Akad. Förhandl. 1875, No. 1.

[5] Homén. A. a. O., pp. 174-175.

[6] S is here the quantity of water vapor whose time of diffusion through one centimeter of air is to be calculated. S_1 and S_0 are the total amounts of water vapor in one cubic centimeter of saturated air at temperatures t_1 and t_0, respectively.—*F. O. S.*

[7] Hann. Lehrbuch der Meteorologie, p. 219.